Platform Independence of Battery Systems

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Nathaniel Wynn | Lead Battery Pack Engineer | nate@ampaire.com

Agenda

1. Introduction
2. Why Platform Independence?
3. Achieving Platform Independence
4. Partnership Opportunities
5. Recap

Nathaniel Wynn | nate@ampaire.com

Introduction

- About Ampaire
  - Mission: To become the world's most trusted developer of practical and compelling electric aircraft.
  - Intent is to deliver electrified aircraft in the very near future with existing technology for immediate environmental impact
- About Nathaniel
  - Rivian
    - Clean sheet battery design through preproduction vehicle fleet
    - ~33 patents pending
  - Lucid Motors, formerly Atieva
    - Optimize basic architecture for use in Lucid Air sedan; push through alpha vehicle fleet testing
    - 5 patents issued

Nathaniel Wynn | nate@ampaire.com

Why Platform Independence?

- Rapid evolution of electrification technology completely changes what is possible faster than aircraft can be certified
  - Resulting changes in fundamental system design parameters
  - Currently, pure electric flight is not compelling for passenger or cargo applications – battery weight is substantial factor
  - Hybrid flight is *very* compelling
- Avoid traps:
  - Re-engineering ($$$) and resultant delay to market
  - Designing around obsolete technology
- A platform-independent battery system can come to market relatively quickly in a thin-haul aircraft
  - Rapidly gain flight and certification heritage
  - De-risk later entry into other markets:
    - Regional transport
    - Larger single-aisle
- A certifiable platform capable of accommodating new cell developments ensures that an aircraft is never stuck with obsolete battery technology

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Achieving Platform Independence

- Start with Small
  - Smaller modules and smaller cells inherently favored by DO-311a thermal runaway testing
    - Easier to prevent cell-to-cell propagation
    - Less energy to contain in worst case full-module involvement
    - Less vent product to handle
  - Determine ideal power to energy ratio for desired flight profiles
    - Example:
      - Power requirement based on climb needs
      - Energy requirement based on climb + cruise + reserve
- Design for Modularity
  - Prioritize identical line-replaceable units = one product to certify
  - Simple, robust battery management system
  - As battery technology improves:
    - Fewer modules needed for same performance = more weight for cargo/pax
    - Minimal re-certification to take full advantage of new cells
- Design for End of Life
  - System must *always* deliver certified power and energy
  - Difference between BOL and EOL = extra battery weight
  - Ampaire has defined 90% state of health as end of life for our products
- Design for Scalability
  - 6-pax: 10x modules
  - 11-pax: 20x
  - 19-pax: 40x

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Desired Partnerships

- Ampaire goals
  - With NASA EPFD Risk Reduction funding, showcase what the industry can achieve in a very short time!
  - De-risk supply chain for Ampaire powertrain and platform development, especially battery
  - Take full advantage of differentiated supplier expertise
  - Willing to discuss Ampaire-as-supplier needs
    - Must align well with Ampaire technology development path
- Partner benefits
  - Accelerated path to market
  - Immediate path to in-flight testbed use
  - Co-development funding for immediate industry needs
  - Develop a system applicable to a wide variety of aircraft
  - Rapid design-prototype-test-learn cycles in application
  - Recognized and differentiated position in electrified aviation industry

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Recap

- Ampaire's mission is to become the world's most trusted developer of practical and compelling electric aircraft.
- In order to bring a compelling electrified aircraft into reality soon, we are working with NASA, among other parties, to identify and solve problems that are roadblocks to innovation
- One such problem is the disconnect between battery technology development and aircraft certification timescales
- Ampaire is looking for partners to de-risk re-engineering costs and timescales, and prevent designing with obsolete technology, by developing a modular and scalable platform-independent battery system
- Ampaire is already flying electrified aircraft, and is eager to test your market-leading products
- Please contact me directly for follow-on discussions:

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